

**ORDER**

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

6650. 9

10/8/91

**SUBJ: REQUIREMENTS FOR AREA CONTROL FACILITY (ACF) UNDER THE FLOOR CABLING**

1. PURPOSE. This order documents the requirements and characteristics of cabling to be routed under raised floors in area control facilities (ACF). It applies to all **ACF intrafacility** cabling.
2. DISTRIBUTION. This order is distributed to the director level in Washington headquarters organizations concerned with **ACF** planning, construction, procurement, and installation of **ACF** cabling and ancillary hardware: Associate Administrators for Airway Facilities and **NAS** Development; **NAS** Transition and Implementation Service; Facility System Engineering Service; **NAS** System Engineering Service; Director, Systems Maintenance Service; Program Manager for Advanced Automation, Program Directors for Automation, Navigation and Landing, Surveillance, Communications and Aircraft Acquisition, and Weather and Flight Service Systems; Manager, Transition Assessment Division; Manager, Facilities Integration Division; Manager, Facilities Transition Branch; Manager, Air Route Traffic Control Center Program; to branch level in Regional Airway Facilities Divisions and the Engineering, Test, and Evaluation Service at the FAA Technical Center; to Regional Airway Facilities **NAS** Plan Coordinators; and to Air Route Traffic Control Center (**ARTCC**) Sectors.
3. BACKGROUND. In the past, much of **ARTCC** cabling has been installed in overhead cable trays, and the requirements for the cables and installation of it are well known. As part of the transition from **ARTCC's** to **ACF's**, the new National Airspace System (**NAS**) equipment, for the most part, is being installed on raised floors, a technique that is prevalent in the computer industry but used sparingly in **ARTCC's**. The use of raised floors is complicated by using the area underneath as an air supply plenum for the **NAS** subsystems because all the interconnecting equipment cables must be installed under the raised floor. The requirements of, and installation methods to be used for, electrical cables located under the raised floor differ from those of overhead cables. In addition, **ACF** construction must be considered to ensure consistency with cabling directives. Wiring requirements for power and signal cables differ, and both must be considered.
4. RESPONSIBILITIES. The Transition Assessment Division (**ANS-100**) has the primary responsibility for developing cabling policy. Policy implementation involves several FAA organizations. Following is a list of organizations concerned with the **ARTCC/ACF** cabling, and their specific responsibilities.

Distribution: A-W(AM/ND/NS/FES/SES/SM/AP/AN/NE/NR/NC/NW)-11  
ANS-100; AM-200; ANS-110; ANS-220, A-X(AF)-3  
A-Z(CN)-3; ZNS-451; A-FAF-3

Initiated By: ANS-110

- a. Facilities Integration Division (~~ANS-200~~).
  - (1) Power panel location and procurement.
  - (2) Review and approval of regional cable layout plans.
  - (3) Review and approval of regional exceptions to the guidelines of this order.
- b. Transition Assessment Division (~~ANS-100~~). Review changes to this order.
- c. Regional Airway Facilities (~~AF~~) Divisions.
  - (1) Prepare cable layout plans for each **ARTCC**, including cable tray system.
  - (2) Procurement and installation of cable trays.
  - (3) Coordinate subsystem cable installation.
- d. FAA Subsystem Project Offices.
  - (1) Cable procurement.
  - (2) Subsystem signal and power cabling must be coordinated with regional **AF** division.

5! SUMMARY. Under the floor wiring shall be accommodated by using cable trays and/or conduit. Power wiring shall be segregated from signal wiring and shall have its own cable tray or conduit. A minimum of eight contiguous inches of clear, vertical under raised floor air space (excluding vertical cable runs), compliant with air flow requirements shall be maintained.

#### 6. RAISED FLOORS.

a. Under Floor Space. The **ARTCC** raised floor typically measures **18** inches from the concrete floor to the top of the raised floor panels. The raised floor area provides cooling air from the area's respective Air Handling Units (**AHU**). This area also contains other equipment including:

- (1) Electrical alternating current (AC) power conduit for equipment and convenience outlets.
- (2) Electrical conduit for fire detection circuits and other control circuits.
- (3) Fire detection heads, usually mounted on raised floor pedestals.
- (4) **Halom** fire extinguishing dispersion equipment.

(5) Cable trays for **intrafacility** communications and signaling cables,

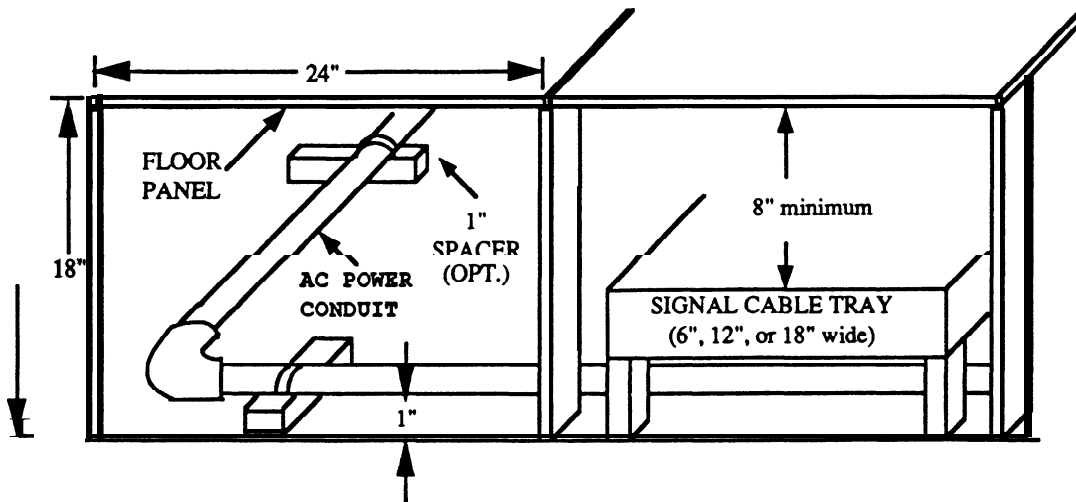
(6) Furred out columns containing duct and vertical risers for cable trays between floors.

**b. Raised Floor Construction.** Raised floor panels measure **24** inches square and rest on stringers attached to the floor pedestals. Due to the difficulty in removing stringers for addition of under the floor equipment, when possible, all under floor systems should be installed as part of the building modification package for raised floor installation.

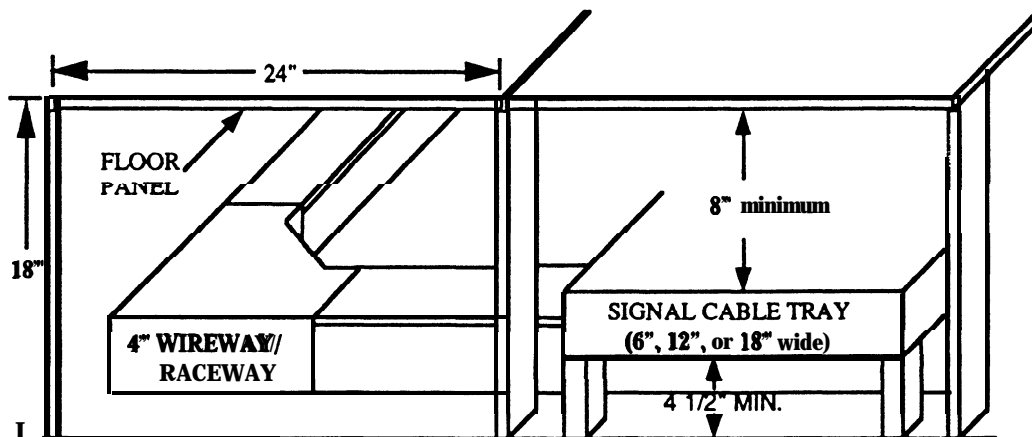
**c. Equipment Layout on Raised Floor.** Equipment layouts should be designed with the **raised floor in mind**. Equipment locations and aisles should be established **modularly** to ensure that there is access to the under floor area from aisles without moving equipment; i.e., equipment should not be located on floor panels providing access to under floor wiring. There should always be an access tile path planned for all wiring runs. Special care should be taken to identify cable paths that may require two cable trays and to provide the resultant additional cable access via floor panels. Access must always be provided to junction boxes, pull boxes, and other safety or service equipment.

**7. AIR PLENUM REQUIREMENTS.** Unimpeded air flow is necessary for the under the floor area to function efficiently as an air plenum. This is to be accomplished by maintaining not less than **8** contiguous vertical inches of free space between the raised floor and the cables. There must be a continuum of the **8** inches of air floor space from the ventilation source, at the air handlers, to the flow destination. One acceptable installation configuration is shown in Figure **8-1**, Cable Tray Construction Details. Any exception to these guidelines or any impediments to the air flow, including vertical cable runs from under the floor to equipment, shall be reviewed and approved by **ANS-200**. Some **ACFs** may have raised floors of less than **18** inches elevation from the concrete floor. The regional **AF** divisions shall specifically review and **ANS-200** shall **approve the** plenum air flow characteristics in such cases.

**8. CABLE TRAYS.** The use of cable trays, when planned in an orderly manner and installed properly, ensures full access to the under the floor cables because the trays are located in areas designated as non-equipment or aisle areas. The regional **AF** divisions shall be responsible for the preparation of a cable layout plan, for each **ARTCC**, that shall be reviewed and approved by **ANS-200**. The plan is to **provide** cable tray paths and to provide assignment of cables to specific paths. This will permit vendors to review the exact path their cables must run and not be concerned about interfering with under the floor fire detection and extinguishing systems and other obstructions. It also permits easy calculation of cable lengths. Figure **8-1** provides an example of cable tray construction details. It will not be necessary for the regional **AF** divisions to prepare cabling plans for the Advance Automation System (**AAS**) as the **AAS** contractor is responsible for the procurement and installation of cable trays and cable associated with the **AAS** project.

**FIGURE 8-1****CABLE TRAY CONSTRUCTION DETAILS**

**A: TYPICAL CONFIGURATION  
SIGNAL CABLE TRAY AND POWER VIA CONDUIT**



**B: TYPICAL CONFIGURATION  
SIGNAL CABLE TRAY AND POWER VIA 4" WIREWAY**

a. Cable Tray Hardware. Selected cable tray hardware shall be compliant with the National Electrical Code (**NEC**). It shall be free of sharp corners or any protrusion that could damage cables during their installation. The cable tray system shall have modular components to permit the use of ~~45-degree~~ corner sections, intersection and "T" section modules, permit cable tray elevation changes and accommodates access to vertical risers. Cable tray width standards of **6, 12, or 18** inches are acceptable.

b. Cable Tray Population. Cables shall be placed in cable trays without being tied down or secured. This will permit easy removal of old cables and installation of new cables. It is permissible to bundle cables with the same source and destination. The cable trays shall be sized for the area control computer complex (**ACCC**) timeframe, and shall further include a **50** percent expansion capability to the extent possible.

c. Cable Tray Routing. Cable run areas are typically along aisles and in other areas where space has not been allocated to subsystems. As a rule, the cable trays and power cable runs, current or future, should be centered under the **24 x 24** inch panels. If there is a choice, the floor panels selected should be closest to the center of the available space, e.g., the center of an aisle. It is acceptable, and may be necessary, to sometimes provide a double (side by side) cable tray run to accommodate large numbers of cables. Double cable trays may be required for radio control equipment (**RCE**) intermediate distribution frame/voice switching and control system (**VSCS**) distribution frame access.

9. A.C. POWER CABLING. AC power cabling is to be segregated from signal/control cable and is to be the lowest tier of cabling under the raised floor. It is a requirement that power wiring be shielded. This can be accomplished either by having the power wiring in conduit or metallic ~~wireway/raceway~~, or by any other method permitted by the **NEC** for the respective automated data processing (**ADP**) and **non-ADP** areas. Figure **8-1** depicts the positioning of the power wiring. It is recommended that a 1-inch standoff from the concrete floor be used in the installation of power cable conduit/raceway to allow air circulation and inhibit moisture collection. However, the specific installation parameters are a regional decision and propensity to flooding damage along with vertical air flow space should be considered in the determination of the exact installation configuration.

a. Receptacles. Power wiring shall not terminate in under floor receptacles. Some subsystems have plug/receptacle power access. It is permissible to use a flexible cable (flexible metallic conduit) from the above floor receptacle to an under floor junction box. It is permissible to use twist lock receptacles for equipment power.

b. Power Cable Routing. Power cables will be routed from the facility power panels to the subsystems equipment. Power cable routing is restricted with regard to its proximity to signal cables. Power cables shall not be closer than **24** inches to signal cables. Adherence to the **24** inch separation may not be possible in vertical runs, however, every effort must be made to maximize the separation. When the vertical planes of signal and power cables intersect, the separation distances do not apply, however, the intersecting angle must be as close to **90** degrees as possible, but shall never be less than **45** degrees.

c. Conduit/Cable Tray Capacity. Conduit/cable trays used for power cabling are to be sized with sufficient capacity to cover all anticipated expansion requirements.

d. Power Panel Cabling. **ANS-200** is planning for the installation of cabling from the facility power source to the facility power panels. Regional **AF** divisions are responsible for coordinating with **ANS-200** and for planning the installation of cable from the facility power panels to facility subsystems.

**10. SIGNAL/CONTROL CABLE.** Interconnectivity between subsystems is achieved by using signal cable. Signal cable is to be routed under the floor and must use cable trays, subject to the requirements of paragraph **8**.

a. Cable Insulation. Cable insulation is to be plenum rated for areas classified as non-automated data processing (**non-ADP**) areas. For **ADP** areas, there is no requirement for cable insulation to be plenum rated. (See paragraph **11**).

b. Optical Fiber Cable. Optical fiber cable, if used, can be routed with copper signal cables and included in the same cable trays. Optical fiber cable is subject to the same insulation material requirements as copper signal cable. Optical fiber cable is not subject to electromagnetic interference and there are no restrictions as to minimum separation distances from power cables other than they shall not be located in the same conduit or cable tray as power cables.

**11. ACF AREA CLASSIFICATION.** The **NEC** contains several sections about under floor cabling. **ADP** and **non-ADP** areas are subject to different sections of the **NEC**. Areas classed as **ADP** areas will have less stringent cabling requirements and these areas are defined in paragraph **11a**. Areas classed as **non-ADP** areas are defined in paragraph **11c**.

a. ACF Areas Classified as ADP. The areas to be classified as **ADP** areas are as follows:

- (1) Raised floor area of the automation wing basement.
- (2) Raised floor area of the control wing basement.

NOTE: Although these areas may contain some space designated for technical support, they have been determined to fall within the guidelines for an **ADP** area.

**b. Cabling Guidelines for ADP Areas.** NEC Article 645 applies to these areas. The following guidelines shall be adhered to:

(1) The **ADP** area must be separated from other areas by fire rated construction. Fire stopping requirements must be adhered to for cable penetrations beyond the **ADP** areas.

(2) The **ADP** areas shall have segregated heating, ventilation and air conditioning (**HVAC**) systems. This means that the air handling units for an **ADP** area shall have an air plenum (under raised floor area) that is ~~segregated~~ from plenums used for **non-ADP** areas.

(3) The **ADP** areas must have means of disconnecting power to electronic equipment located in the **ADP** area and to **HVAC** equipment located in or serving the **ADP** area. The disconnect control shall be located so as to be readily **accessible** at the principal exit doors and shall have clear identification as to the area being controlled.

(4) Plenum rated signal and control cables ARE NOT REQUIRED,

(5) The branch circuit to receptacle supply cables must have a metal sheath or be enclosed in metallic conduit or metallic **wireway/raceway**.

**c. ACF Areas Classified as Non-ADP.** Areas classified as **non-ADP** areas include:

(1) Raised floor area of the control wing first floor. This is the entire control room.

(2) Raised floor area of the automation wing first floor,

**d. Cabling Guidelines for Non-ADP Areas.** NEC Article 300-~~222~~ applies to these areas. The following guidelines shall be adhered to:

(1) Signal cables installed under the raised floor must be either plenum rated or within a non-ventilated metallic enclosure, **e.g.**, a conduit or **wireway/raceway**.

(2) It is noted that for **non-ADP** areas, the **NEC** lacks requirements for disconnect switches (electronic power and **HVAC**) to be located at **principal exits**.

(3) The branch-circuit to receptacle supply cables must have a metal sheath or be enclosed in non-ventilated metallic conduit or non-ventilated metallic **wireway/raceway**.

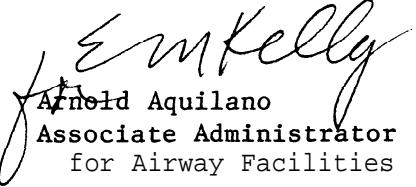
## **120. MISCELLANEOUS CONSIDERATIONS.**

**a. Equipment Location Restrictions.** Grounded equipment frames must not be installed **within** 3 feet from power panels or within **3.5** feet from air handling units.

b. Radio Frequency Interference. Power panel radio frequency interference suppression plates are required. The plates are secured to the concrete floor and are typically 12 inches wide. The use of these plates is discussed in Federal Information Processing Standards Publication 94.

13. ADVANCED AUTOMATION SYSTEM (AAS) CABLING CONSIDERATION. This order applies to the AAS with the exception that the AAS contractor is responsible for the design and installation of cable trays/conduit for the AAS subsystems. The cabling plans are to be coordinated with and approved by the regional AF divisions and ANS-200. The AAS includes the ACCC, initial sector suite subsystems (ISSS) and its subelement, the dynamic simulation (DYSTM) common consoles, the AAS local communications network (LCN) and the terminal advanced automation system (TAAS). Since the VSCS console equipment (VCE) is installed in the ISSS common consoles, current planning calls for the AAS contractor to plan and install the cables for VCE. The cables from the main VSCS complex to the VCE are to be Government furnished equipment (GFE) to the AAS contractor.

14. EXCEPTIONS. Exceptions to the guidelines provided herein are permitted. Due to the several variations in ACF size and layout, there will be cable plan variations. It is the responsibility of ANS-200 to approve/reject any exceptions to the guidelines provided herein. Exceptions should be made only after analyzing all of the safety, capacity, performance and cost factors.

  
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for Airway Facilities